SCIENCE

VOL. 96 FRIDAY, OCTOBER 2, 1942 No. 2492

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

Lancaster, Pennsylvania

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

MOLDERS OF A BETTER DESTINY[1]

By Dr. CHARLES M. A. STINE

VICE-PRESIDENT AND ADVISER ON RESEARCH AND DEVELOPMENT, E. I. DU PONT DE NEMOURS AND COMPANY, INC.

IN fighting a war, the all-absorbing intent is to win. There is little time to analyze the rush of events or to appraise their consequences beyond the war's end. The united objective is rightly success for our arms.

Yet under the pressures of a great war there may be compressed scientific, economic and social developments that might have taken many decades to achieve under less urgent conditions. Their effects on our lives and all civilization may be more wide-reaching and lasting than any military conquest. They constitute one of the most imperative incentives to victory.

No American, least of all any scientist worthy the name, conceivably could endorse war as a justifiable means to progress. The destruction of life and property wrought by the present war far exceeds the havocs of a century's earthquakes. Most of mankind is burning itself on an altar of paganism.

Nonetheless, one fact is inescapable. Despite the recurrent malady of war, history's over-all course is forward. Mankind has the habit of rising phoenix-like from its own ashes to attain greater heights. Progress is immortal.

We emerged from the First World War with a wholly new concept of our possibilities. For the first time we began clearly to see that when the Creator conferred upon man freedom of choice and action, there were placed in man's hands the tools with which he could shape his destiny and modify his future. We learned that it was possible not only to emulate nature but even to excel her in certain fields of creation. We were shocked at how little we knew and at

[1] Address before the General Session of the American Chemical Society, Buffalo, N. Y., September 7, 1942.

how meagerly we had advanced in the light of what was still to be accomplished.

The new nation—and it was no less—that was built on this continent following 1918, largely as a result of the war-broadened vision, would have seemed a fantastic wonderland in 1914 had anybody then had the imagination to predict it.

The automobile came of age; aviation was established as a potent industry; the "wireless" of war days became "radio," and radio approached the miraculous in the marvel of television. Add to these the gigantic expansions realized by the telephone, the motion picture and rayon, all three of which were undeveloped infants in 1914, and you have a combination of influences truly staggering in their effects upon American life.

One of the greatest migrations of all time took place as millions moved from farms to cities and more millions from cities to suburbs. This mighty trek, made possible by improved transport, better highways and opportunities for more lucrative employment, paralleled further drastic changes in our traditional economy. We had led the world in agriculture; we now led it also in industry. Mass manufactures superseded the handicrafts almost to their extinction.

Meanwhile, the American woman had taken her destiny into her own hands. In 1914, she wore long skirts, cotton stockings, whalebone stays, and her "place was in the home." She came out of the war with a declaration of feminine independence that has since taken her to Congress, into the Cabinet and into almost every activity once sacred to man, including the military. In less than a decade she cut the bonds of centuries and destroyed for all time a hundred circumscribing taboos. Only the future historian can assess the full impact of this new freedom upon the family, the community and the nation. It was undoubtedly speeded to fruition by the First World War.

There were other advances—you are as familiar with them as I am. When we, the American people, on the seventh day of December, 1941, found ourselves again at war on a global scale, we were living on a plane that bore but little resemblance to the pre-war period of a quarter century earlier. Our clothes, our food, our homes were different. The character of our work was changed. Our environment and thinking were those of a new age.

Millions of dollars had become hundreds of millions in our national planning. Private industry risked tens of millions on ventures that earlier would have commanded hardly a tenth as much. Hosiery and furniture alike were being made from coal, water and air; dresses from wood, farm fertilizers from the atmosphere, camphor from pine stumps. These and many other achievements of chemical synthesis had altered or made obsolete trade practices and customs as old as the race.

Moreover, the scientist was just getting started. Tens of thousands of new chemical compounds and metallic alloys awaited his full exploration. We were speculating on the eventual conquest of disease. The elimination of poverty, at least as a social problem, was considered a goal that well might be realized. And, as organic chemistry was the source-spring of a major share of the infinitude of changes that inspired such hopes, the influences of the First World War could be very definitely traced here also. Our organic chemical industry in the United States grew directly in answer to needs made violently evident by that war.

It is unnecessary to detail to chemists what has happened in chemistry since 1914. That year, a mere handful of 528 workers made up the nation's total employment in the production of coal-tar chemicals. American-made dyes were not even listed in the official census reports. Our farmers had to buy German potash and Chilean nitrate. Our physicians looked to Europe for important drugs, sutures and optical glass. All science looked to Europe for leadership.

Indeed, it was a simple, almost a scientifically primitive economy in which we Americans then lived. On all the seven seas, America-bound ships heavy with goods and raw materials testified to our dependency on foreign lands. The homes in which we lived differed little from those of our great-grandfathers; the tailors of the Caesars knew the textiles of which we made our clothes; the finishes of our 1914-model horseless carriages dated to ancient Egypt and the building of the Pyramids. All steel rusted. The best rubber tires were worn out after about 3,000 miles of highly uncertain road service.

One shudders at what might be our plight if those were the tires of to-day, or if by some colossal blunder we had failed to establish an organic chemical industry in the United States as a consequence of that other war's bitter lessons.

Thank God, we did establish a chemical industry!

We did more than that. We established a nation-wide common consciousness of the power of science in every branch of American industry. Steel, textiles, transportation, foods, oil, in fact, every basic producer came to the turn in the lane where all signposts of progress pointed in one direction—to the research laboratory. We did not get there all at once, but most of us got there long before German hobnailed boots were pounding over the streets of Warsaw.

Expenditures for industrial research in the United States rose from an inconsequential sum yearly in the pre-First-World-War period, to an amount estimated

at 300 millions of dollars yearly in the pre-Second-World-War period. The number of research laboratories grew to more than 2,000. Huge sums were spent in expanding technical and scientific schools to meet the demands of our awakened youth. The number of doctorates granted in chemistry alone was multiplied by twenty or thirty times.

I am not implying that all research is chemical or that chemistry provides the one Aladdin's lamp which all scientists must rub. However, let chemistry be ignored and the other lamps become lifeless brass. Perhaps the greatest benefit that has come to America from our chemical awakening is the renascence of all science that has accompanied it. The chemical synthesis of vitamins, for example, to say nothing of hormones and the sulfa drugs, not only is revolutionizing medicine and dietetics but putting these sciences on incomparably higher planes of performance and future promise. And at the opposite extreme of the pendulum's swing, the modern long-range bomber, while a machine, is also a composite chemical triumph expressed in metals, plastics and liquids.

The famous tribute paid Washington—first in peace and first in war—might be paid with equal justice to chemistry. Its record during our other world war is history. Its contributions to the nation's progress during the peaceful years of the '20's and '30's while the organic chemical industry grew to maturity, helped crowd into those years many of the most notable advances that mankind has gained since civilization began.

Now, we are again at war. With the full strength and vigor of its young manhood, the chemical industry is fighting again for an American victory and an American peace. To this task wholly it has dedicated itself wholly.

And we hear questions: Is the fight worthwhile? Will a victorious peace be worth the price that all too evidently we will need to pay for it? After victory—what?

My answer is that now, to-day, even as I speak, the pressures of this war are compressing into the space of months developments that might have taken us a half century to realize if necessity had not forced the pace.

Those pressures are unprecedented. The developments are unprecedented. Give us a victorious peace and the freedom of enterprise it should guarantee, and our progress will be unprecedented!

One does not need to venture into prophecy to sketch the bold lines of what that progress can be. They have already been traced. Already our world of 1940, in which we took such pardonable if mistaken pride, is so distant in the past that it has become an antiquity, as seen through scientific eyes. The inconceivables of two years ago are to-day's realities.

More than a century was consumed in bringing the crude rubber production of the world up to a million tons yearly. The United States alone is now undertaking to accomplish almost as mighty a feat in less than two years, by the manufacture of chemical rubbers from petroleum, alcohol and coal and limestone.

By the end of 1943, our production of aluminum will be at a rate almost seven times greater than was attained in 1939 after fifty years of intensive development. And we will be recovering from brine, sea water and other sources approximately 100 times the amount of magnesium that was produced in 1939, when the magnesium industry in America was 24 years old.

Our aviation industry is establishing facilities for the manufacture in one year of almost double the number of planes it produced throughout the 37 years of its history beginning with the Wright brothers at Kitty Hawk and culminating in the Defense Program. Meanwhile, largely as a result of chemical advances in fuels, plastics and light metals, aircraft engineers are designing trans-oceanic planes capable of flying to Europe and back non-stop, carrying payloads of 20 tons. The projected planes are quadruple the size of the famous "Clipper" planes that pioneered in inaugurating transatlantic commercial air service.

The nation will emerge from this war with capacities for making plastics, synthetic fibers, nitrates, hydrocarbons, high octane gasolines and literally scores of chemical and other raw materials on a scale that only two years ago was beyond our comprehension. The changes that have taken place in our thinking and planning approach the unbelievable when one detaches himself from the present long enough to regain the viewpoint of only the recent past. The first proposal that we build 50,000 war planes left us incredulous. We asked how could we maintain such a vast fleet, even should it be built, or train the men to fly it. Now, the demand for 125,000 war planes in a single year is met with the answer, "Give us the materials and we'll give you the planes, as ordered."

In terms of dollars, the hundreds of millions of that bygone economy stemming from the First World War have suddenly become tens of billions! A million dollars is hardly pin-money in our planning!

Few of us, even among scientists, grasp the technical implications of these enormous projects which are becoming facts with emergency speed. The aluminum-producing capacity being created will furnish in one year metal enough to build thrice the number of passenger cars now operating on all American railroads. To produce this aluminum will require more elec-

tricity annually than was consumed in 1940 in 27 of our 48 states. Despite wartime tax schedules and wages, aluminum ingots now cost 25 per cent. less than in 1940, and further economies are forecast through savings in fabricating costs. Aluminum has become a major metal.

Magnesium is about 60 per cent. the weight of aluminum and about one fifth the weight of steel. It sold, in 1915, for $5.00 per pound and until a few years ago was a structural curiosity. To-day, measured by cubic feet, magnesium at 22½ cents a pound is cheaper than aluminum selling at 15 cents a pound, and almost a half ton of it, on the average, is going into every American fighting plane that is built. After the war, the nation's capacity for producing this lightest of all structural metals will be more than double its aluminum output of 1939.

Equally significant is the source of most of the magnesium now employed industrially. For the first time in the history of the world a structural metal is being obtained from the sea by a chemical process. Huge pumps force 300,000,000 gallons of sea water daily through intricate apparatus. At present, magnesium and bromine are the only products precipitated, but ocean water contains traces of every element found on land. Are we opening a new field of chemistry, far more bizarre than any of the imaginings of fictionists? Nobody knows as yet.

In turn, steel is challenging the light metals. Low alloy steels and new modifications of the higher alloy steels, fresh from the laboratory, are bidding for expanding uses in aviation and wherever lightness and strength are requisites. In the steel industry to-day, technicians speak confidently of monster aircraft that will be largely steel. These new alloys are three times the weight of aluminum and almost five times the weight of magnesium, but their tensile strength approximates 190,000 pounds to the square inch. This advantage permits weight to be shed by reducing bulk and eliminating needless supports.

The larger planes grow in the future, say the chemists of steel, the more pronounced will be the trend to the new steel alloys. Less subject to corrosion than plain steel, they are more easily corroded than aluminum, but this problem in protection is said to be on the way to early solution. So watch steel in the mounting competition of light metals.

By all means, too, watch petroleum. Some years ago it was believed that the ultimate in motor fuel would be reached by the creation of a gasoline equivalent in power and anti-knock qualities to pure iso-octane. So superior was iso-octane in these respects that it arbitrarily was given an octane number of 100, which became the standard in evaluating all gasolines. But that was before the Battle of Britain.

The epic fight of the Royal Air Force to save England, raging month upon month against odds, was also a chemists' fight to produce better fuels—fuels that would get planes into the air in a fraction of the former time, that would give greater and yet greater speeds, longer and yet longer ranges. The American chemist was in that fight because he knew more about motor fuels than any other chemist on earth. The Battle of Britain became a testing and development laboratory in which a nation's life was the stake.

The work done in that laboratory, and in our laboratories here at home as an outgrowth of that experience, has precipitated changes in motor fuel technology of which the effects will be reverberating long after the peace. Fuels now can be made that go beyond the octane scale. Their estimated octane numbers are of the order of 110 or 115 and even higher. They deliver one half again as much power as 100 octane fuel. Looking upon the situation that is indicated for after the war, the petroleum chemist now sees all existing motors as out of date, with knowledge of fuels advancing so rapidly that September's motor might be out of date in October.

Let us glance at another phase of petroleum chemistry. A barrel of crude oil contains literally thousands of chemical compounds. The chemist has long been fascinated by the possibility that almost anything under the sun might be created with these chemical building blocks of hydrogen and carbon; that simply by the addition of oxygen and other elements in the proper combination, he might obtain new alcohols, esters, acids, solvents, perfumes, pharmaceuticals and organic synthetics of every type. Catalytic cracking processes and adaptations of them, brought very recently to high stages of performance, are now leading toward this goal and taking petroleum chemistry into a realm once exclusive to coal-tar chemistry.

The largest catalytic cracking capacity in the world is being operated by American oil companies. Soon this capacity will approximate some hundreds of thousands of barrels daily. The significance of this development, well underway in 1939 but expanded to gigantic size by the needs of war, is beyond all present vision. Synthetic rubber, which, as every chemist knows, is not rubber at all but a new material of broader and yet more promising utility, is being produced from butadiene and styrene synthesized from petroleum. Toluene, best known as the basis of one of the most important of modern high explosives but also essential in dye chemistry and many other industries, is now a petroleum product.

With almost equal facility the petroleum chemist can give us ethylene, on the one hand, or benzene on the other, and supply them in quantities measured in hundreds of tons daily. This feat might be likened to

drawing wine or water at will from the same cask, or getting beef or pork from the same animal, inasmuch as ethylene and benzene are members of quite different chemical families. Practically, they are employed in such diverse uses as the manufacture of styrene plastics, both the Buna and Thiokol types of synthetic rubbers, drugs, dyes and nylon. Moreover, acetylene can be produced from refinery gases to furnish the principal intermediate in the manufacture of neoprene.

Germany's early mastery and world monopoly of the production of benzene, toluene and other coal-tar crudes and intermediates—her then "secret weapon"—brought her armies almost to victory in the First World War. It was only by prodigious effort and at huge cost that private industry in the United States was able, during and after that war, to win independence in these chemicals, which are part and parcel of the nation's economic life-blood both in peace and war.

To-day, we are doubly independent. Our coal-tar chemical industry is securely established. In addition, the possible output of benzene and toluene from petroleum is many times their peak output from coal tar. Furthermore, in super motor fuels, which may well be this war's deciding weapons, we are excelling the enemy's best in quantity and quality alike. Where Germany stood in 1914 with coal tar, the United States stands to-day with petroleum.

A sign of the swiftness of the pace with which the hurly-burly of change is sweeping the petroleum industry is given by a printed card that now hangs behind the desk of the research director of one of America's greatest oil companies. The card reads: "You don't have to be crazy to work here, but it surely helps!"

May I add that a similar card could be hung with profit in every American office and shop and laboratory and farm barn. We are going to need to be "crazy," as judged by 1940's thinking, to make this upset world right again. We are going to need to be visionary to the point of audacity, in the light of to-day's evident facts, to discharge just a fair share of the post-war opportunities and responsibilities.

Plastics were of sensational promise before Pearl Harbor. The newest and most versatile of plastics will be available after this war on a scale beyond all previous conceptions. The high-pressure synthesis of ammonia, one of the major chemical exploits of the century, will have taken on an industrial status that, in terms of new producing capacity, may be comparable to the discovery of a sixth continent. The amount of fertilizer chemicals that this new capacity will be able to supply farmers for fertilizers will be so large that the basic trends of agriculture might be changed. And these are but one group of a hundred or more products stemming from this high-pressure synthesis, which utilizes air, water and coal as its building blocks.

We will have glass that is unbreakable and glass that will float, wood that won't burn, and laminations of plastics and wood that will compete with the structural metals. Hosiery derived from air, water and coal, a wonder of pre-war days, is but the forerunner of many innovations from the same source, ranging from shoes that contain no leather and window screens that contain no wire, to machinery bearings that contain no metal.

At the moment, we are handicapped by shortages. Scarcity as such is not the reason for them, however. Never has there been so great a plenty as measured by our ability to produce, and that ability grows by the hour. The shortages are the consequences of the diversion of goods to war, and from ourselves to others. To-day, we produce to destroy.

But to-morrow we will produce to build, and we will continue to invent and thus to multiply our possessions. Released by an American victory, the stream of production, compared with its volume in the past, will be as a great river is to one of its tributary creeks. We will have at our command ten, fifty, a hundred times what we had before, chiefly of new materials.

That prospect is as certain as to-morrow's dawn. We need only to make the victory definite. Then, the choice will be ours, either boldly to harness the stream of plenty, or, if we are timid and of myopic or restricted vision, to be embarrassed by the very abundance of means we have created.

If I know the American chemist, his will be the bold course—the course toward a better destiny. And all science will set its course by the same compass!

Possessing the tools, the experience and the knowledge that we now have, we should be unfaithful servants indeed if, upon the coming of peace, we merely buried the talents charged to our keeping. Means will be at hand to perform feats that men have long dreamed of doing.

Fuels and metals and plastics are now ready to complete the revolution in transportation begun early in the century. The automobile manufacturer's slate has been wiped clean for a fresh start, which should result in new cars that will be of incredible efficiency as judged by present standards. Since motor car production stopped, the shiny new models that are now gathering dust in dealers' storerooms have aged, technically, at least two decades. We are now in the 1960's of motor cars, as measured by the old pace of development.

Sealed cooling systems, proved on large-scale by aviation, may end in the post-war car the nuisance of adding water to radiators. Weights may be half what

they are, saving from 1,500 to 2,000 pounds of useless load. The power output per cubic inch of piston displacement may double, treble and even quadruple. Fuels may yield 50 miles to the gallon or better.

In the oil industry they are speculating on fuels with octane ratings of 150, or almost twice that of the best automobile gasoline of two years ago. They say gasoline itself may be displaced by a superior petroleum product. They are talking of the practicability of midget automobiles for children.

Instead of rubber alone, there will be a hundred and one rubbers for tires and other uses. In tires, the indicated range is from all natural rubber casings, through varying combinations of natural rubber and synthetics, to the all-synthetics. When one remembers that at present the synthetics are being adapted to tire specifications written for rubber and that the truly synthetic-type tire is yet to be engineered, the prospect is one of progressive changes.

The upsurge of automobile technology will be paralleled in aviation. Designers are thinking in terms of hemisphere-spanning freighters and of passenger aircarriers in fleets numbering hundreds of planes. Transcontinental non-stop air trains of gliders, which would drop off or pick up "coaches" over the principal cities enroute, are no longer figments of an imaginative air man's dream. They are probabilities. Leaders of the industry say that technical considerations no longer limit the size of airplanes that can be built.

Now present are most of the elements essential to the wide popular ownership of planes. Small, highly efficient, almost foolproof craft can be produced at low cost. An enormous plant capacity will be awaiting utilization, tens of thousands will have been trained in flying, and the post-war land will be dotted with air fields. Only within very large cities will we be deficient in field facilities, and there too the signs of impending change are clear.

As never before we are conscious of the need for cheaper and better housing. Crowded city slums stand as an ugly reproach to our lack of initiative and vision in home-building. The slums should be emptied after the war by the combination of forces that is being arrayed against them; and once empty, airports might well take over those bleak blocks.

Lower-cost motor cars, which will draw still more thousands of city dwellers to suburbs and country, represent one of the forces that is going to help empty the slum. Public opinion, shaped by a more enlightened conception of the basic needs of healthful living, is another. The third will be the better housing that so long has been awaited. It is coming.

It is coming because in no better way will we be able to put into worthwhile service the abundance of materials suitable for building all kinds of things. The very prospect of this plenty, on the one hand, and the all-too glaring lack of inexpensive modern housing on the other, have started men thinking who have given but little attention to this problem in the past. The engineer, the chemist, the production expert and the development departments of some of our largest companies are alert to an opportunity, and will become productively interested the moment the war releases their services.

Thus far, only general objectives have taken form. They are for homes costing in the order of $500 to $800 per room. Prefabricated sections, which can be easily handled by two men, will permit flexibility in architectural designs. New insulating materials, making possible light walls that will be several times as efficient as heavy masonry ones, will allow the use of revolutionary structural principles.

Plywood, plastics, rustless steels, non-ferrous alloys, various types of composition board, fire-resistant woods, ceramics and synthetic finishes of lasting durability will be employed in profusion. For example, stainless steel is indicated as a common roofing material of the future. It will last as long as the house and require no maintenance. Lighting will be automatic, governed by electric "eyes" sensitive to outside variations in the daylight. Air-conditioning units will filter out the pollens of hay fever and asthma.

The movement for better homes marches side by side with that to educate the public in better diet. I venture to say that more popular training in the chemistry of food and its digestion has been crammed into the past two years than was given in the preceding two centuries. The knowledge of food's real values to the body that is flowing from sound scientific studies of broad scope is accumulating means of incalculable power to prolong life.

Science, too, follows the flag. This war, spreading over all zones and into all climates, presents a challenge to American medicine that is without precedent. That challenge is being met by a mobilization of all the sciences that likewise is without precedent in man's fight against disease.

The weapons being employed are unique to our time. They include the ultra-centrifuge, in which there is a peripheral speed of the rotating disk comparable to the velocity of a rifle bullet. Still another is the electron microscope, the largest of which now being built at Stanford University is expected to magnify 150,000 times. Mention should also be made of the giant cyclotrons, sometimes referred to as "atom smashers," with which it is possible to transform certain ordinary elements into wholly different elements possessing

radioactivity. In addition, synthetic organic chemistry is making an ever-increasing and significant contribution to remedial medicine.

The single objective of this mobilization of science against disease is to prevent suffering and save human lives, irrespective of color or creed. The results which are certain to accrue may ultimately outweigh by many times even the staggering losses of the world-wide conflagration.

Taking an over-all look at the current press of events, one notes that, perhaps, the most important of all the signs pointing to better days is the fact that the emergency of war has dissipated innumerable inertias, each an interruptant of progress. Normally, the new is received with suspicion. People cling to the old and tried, are loath to experiment, slow to change. With peace, however, the usual slow developmental process will have been reversed. War shortages of conventional materials will have resulted in eager trials of every new material science and industry could offer. And countless of the "substitutes" will have proved their superiority. Thus, an experience with and an acceptance of the new will have been gained that ordinarily might have taken many years to achieve.

No doubt, some will become alarmed over the possible displacement of old materials and old industries. Changes of a drastic nature are inevitable, but they seldom result in the hardships that the timid predict. More wrought iron is being used in the world to-day than when wrought iron occupied the province now held by steel. The horse and buggy vanished, but the buggy manufacturers who were alert rose to new affluence with the motor car. The coal-tar colors ended the centuries-long reign of natural dyestuffs, but the dyestuffs industry has grown to many times its former size, and spawned a dozen new industries in addition.

Progress means going forward. It must build more than is destroyed or it does not merit its name. Not only should it be of a tangible, material character, but it should contain the elements of greater spiritual growth for the individual and community alike. It should lift the chin and put a new spring into humanity's step.

The President of the United States has said that we are fighting for four freedoms—freedom from want and freedom from fear, freedom of speech and freedom of religion. A former President of the United States, Herbert Hoover, has added that a fifth freedom is also mandatory in the victory—freedom of economic enterprise.

The scientist accepts these freedoms unreservedly. To their attainment he is glad to give life itself, if that is the price. But the scientist is fighting just as wholesouledly for five hundred, yes, for five thousand other freedoms.

The freedom to work, to expand the intellect, to worry through with a theory until it is validated or disproved; the freedom to banish the wasteful and enthrone the efficient; the freedom to improve, if he can, everything that exists under the sun, and beyond that to create things upon which the sun has never before shone—these, too, are freedoms for which the true scientist fights.

As a man, he fights for the freedom to better his lot and for the rewards that ability merits. As an incurable altruist—and the true scientist is one—he fights even harder for the freedom to better the lot of mankind, that each generation may rise to heights loftier than any won by its predecessor.

A soldier of peace, he fights for the freedom to mold a better destiny, both for the individual and for the race.

These freedoms have always been America's. We fight to keep them America's. Let our swords be mighty, and mighty indeed will be our plowshares.

SCIENTIFIC EVENTS

RECENT DEATHS

DR. THOMAS MILTON PUTNAM, professor of mathematics at the University of California, died on September 22 at the age of sixty-seven years.

DR. HOMER CLYDE SNOOK, consulting engineer of Summit, N. J., known for his work on electronics, died on September 22 at the age of sixty-four years.

DR. EDWARD FAWCETT, since 1934 emeritus professor of anatomy, previously from 1909 to 1934 dean of the faculty of medicine at the University of Bristol, died on September 22 at the age of seventy-five years.

DR. DAVID WATERSTON, since 1914 Bute professor of anatomy at St. Andrews University, died on September 4 at the age of seventy-one years.

TECHNOCHEMICAL LECTURES, 1942–1943, OF THE MELLON INSTITUTE

A SERIES of lectures on recent advances and current trends in the American chemical industry will be presented by technologic specialists of Mellon Institute of Industrial Research during 1942–1943. These discourses, which will be delivered on alternate Wednesdays, in the fourth period (11:30 A.M.–12:30 P.M.), throughout both semesters, in the auditorium of the institute, will be open to all students in the profes-

sional courses in chemical engineering and chemistry in the University of Pittsburgh, as well as to the institute's members.

1942

October 7. War Problems of the Chemical Industries, Dr. E. R. Weidlein.

October 21. Recent Changes in the Manufacture of Heavy Chemicals, Dr. F. W. Adams.

November 4. Present Importance of the Synthetic Organic Chemical Industry, Dr. B. G. Wilkes.

November 18. Opportunities in Fuel Conservation, Dr. H. J. Rose.

December 2. Chemical Technology of Petroleum in Wartime, Dr. W. A. Gruse.

December 16. Advances in Manufactured Gas Production, J. A. Shaw.

1943

January 6. Synthetic Resins To-day and To-morrow, Dr. R. L. Wakeman.

February 17. Our New Synthetic Rubber Industry, Dr. Claire LeClaire.

March 3. Vitreous Enameled Products as Engineering Materials, Dr. E. E. Marbaker.

March 17. War Problems in Building Materials Technology, Dr. H. E. Simpson.

April 7. Economic Status of Heat-Insulating Materials, R. H. Heilman.

April 21. Solving Corrosion Problems in the Chemical Industries, Dr. G. H. Young.

May 5. Progress in Sanitary Engineering, R. D. Hoak.

May 19. Health Conservation in the Chemical Industries, Dr. F. R. Holden.

STUDENTS IN THE ARMY ENLISTED RESERVE

THE HONORABLE HENRY L. STIMSON, Secretary of War, issued on September 17 the following statement:

Last week I announced that college students who are members of the Army Enlisted Reserve will all or for the most part be called to active duty at the end of the term now beginning, and thereafter, as they reach Selective Service age. This action had been foreseen as a possibility, and in every presentation of the Enlisted Reserve plan to college students and college authorities it was clearly stated that enlisted reservists were subject to call at any time when, in the opinion of the Secretary of War, the exigencies of war demanded it. This statement was made by me personally in the original announcement of the plan on May 14.

In public addresses by War Department officials on the subject of the Enlisted Reserves, the fact that the members were subject to call at any time has been emphasized and repeated. For example, last July 4, Mr. Harvey H. Bundy, Special Assistant to the Secretary of War, addressing a freshman class, said: "There is no commitment that any man may complete his college education." This address containing that statement was distributed to the colleges.

In view of admonitions of this nature, which have been a consistent part of the War Department's Enlisted Reserve policy from the first, and the increased seriousness of the war, the notice that the call to duty would come early in 1943 should not have occasioned great surprise.

However, my statement, together with other recent press reports, has been interpreted in some quarters to mean the end of all higher education for the duration of the war. This is a misapprehension that should be corrected.

The Army is greatly in need of men of specialized training, particularly in physics, chemistry, engineering and medicine. We are equally interested in having adequate numbers of men of such training available to war production industries and the civilian research agencies of the government. Plans are now being worked out for the method of training of those inducted into the Army, but in any event it is hoped that the colleges will maintain their training of students in engineering, medicine and other sciences. In some cases, it will be necessary to expand this training. Occupational Bulletins of the Selective Service System have been issued from time to time which relate to college students in these fields essential to the war effort. I now re-emphasize the fact that where students in these fields and their teachers fall within the classifications for deferment by the provisions of these bulletins they are doing the job their country wants them to do and are performing their full duty in the war effort.

Young men who have joined the Army Enlisted Reserve or who now enlist in it should proceed with their studies until they are called to active duty. When they are called, the Army will utilize for their further training such facilities of its own as it may have or of the colleges as it deems best to meet military requirements as they then exist. The intervening time will afford a period of adjustment and for the formulation of plans for such additional specific training as seems indicated.

These plans, which will probably include a modification of the college ROTC courses, are now under study. When they are completed, the committee of educators appointed by the American Council on Education will be fully informed, and consulted as to the details of their application.

STANDARDS DIVISION OF THE OFFICE OF PRICE ADMINISTRATION

THE newly created Standards Division of the Office of Price Administration, of which Dexter M. Keezer is deputy administrator and acting director, was organized for the purpose of incorporating quality definitions in price, rent and rationing regulations. The new division will have seven sections as follows: Food and Drugs (which also will handle paints and chemicals for the present); Textiles, Leather and Apparel; Consumer Durable Goods; Home Furnishings; Lumber and Building Materials; Agricultural and Industrial Machinery; and Rubber and Rubber Products. Sections to handle fuel and petroleum products; chemicals and paints; transportation equip-

ment; paper, paper products and containers; and metals and metal products, as well as a commodity testing branch, are being organized.

Culver S. Ladd, for many years state food commissioner and chemist of North Dakota, is chief of the Food and Drugs Section. The head of the Textiles, Leather and Apparel Section is H. S. Schenker, of Philadelphia, whose entire business career has been devoted to textile qualities. Earl A. Graham, senior engineer of the engineering firm of Sanderson and Porter of New York, has been placed at the head of the Consumer Durable Goods Section. Erwin G. Adelberger, interior architect and designer, of Cleveland, Ohio, is head of the Home Furnishings Section. Elroy A. Ledwith, architect, who became associated with the defense program in September, 1939, as consultant on housing standards to the National Defense Advisory Commission, is chairman of the Lumber and Building Materials Section. H. Seymour Pringle, assistant professor of agricultural engineering on leave from Cornell University and since 1926 extension specialist in agricultural engineering at the New York State College of Agriculture, has been made head of the Agricultural and Industrial Machinery Section. The Rubber and Rubber Products Section has as its acting head Theodore M. Miller, of Baltimore, consulting chemist. M. L. Egert is the administrative officer of the division.

APPOINTMENTS AND RESIGNATIONS AT FIELD MUSEUM, CHICAGO

DR. FAY-COOPER COLE, chairman of the department of anthropology of the University of Chicago, has been appointed research associate in Malayan ethnology at Field Museum of Natural History. While his principal work will continue to be at the university, he will serve in a consultative capacity with other members of the museum staff. Dr. Paul S. Martin, chief curator of anthropology, has been appointed research associate (with the rank of full professor) in the department of anthropology of the university. Although continuing his work at Field Museum, Dr. Martin will from time to time give special lectures for classes at the university, and later will give a special course in museology or the technical operations of a museum. These appointments are in furtherance of a plan for closer cooperation that has been adopted by the university and the museum.

The appointment was also announced of Dr. Albert A. Dahlberg, formerly head of the dental clinics at Billings Hospital and now a Chicago practicing dentist, as research associate in paleontology.

Elmer S. Riggs retired on September 24 from active duty as curator of paleontology. He has been associated with the museum continuously since 1898. He will take up his residence in Lawrence, Kansas. Except for a year as museum assistant at the University of Kansas, from which he was graduated, Mr. Riggs has spent his working career as a member of the staff of the museum, going there shortly after he had completed his post-graduate work at Princeton University. During this period he has conducted sixteen important fossil-hunting expeditions—twelve in the western United States, two in Canada and two in Argentina and Bolivia, spending a full four years in the last-named countries.

He is succeeded as acting curator in charge of the division by Bryan Patterson, a member of the museum staff since 1926 and assistant curator of paleontology since 1935.

OFFICERS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

HAROLD V. COES, vice-president of Ford, Bacon and Davis, Inc., New York, according to an announcement made by C. E. Davies, secretary of the society, has been elected by a letter ballot of the 16,250 members of the American Society of Mechanical Engineers to be president of the society during 1943.

Vice-presidents elected at the same time to serve two-year terms on the council were Joseph W. Eshelman, president, Eshelman and Potter, Birmingham, Ala.; Thomas E. Purcell, general superintendent of power stations of the Duquesne Light Company, Pittsburgh, Pa.; Guy T. Shoemaker, vice-president, Kansas City Light and Power Company, Kansas City, Mo.; Walter J. Wohlenberg, professor of mechanical engineering, Yale University.

Managers of the society elected to serve on the council for three-year terms include Roscoe W. Morton, professor of mechanical engineering and head of the department of the University of Tennessee; Alexander R. Stevenson, Jr., staff assistant to the vice-president, General Electric Company, Schenectady, N. Y.; and Albert E. White, director of engineering research at the University of Michigan.

The new officers will be installed during the sixty-third annual meeting of the society to be held in New York, N. Y., at the Hotel Astor, from November 30 to December 4.

SCIENTIFIC NOTES AND NEWS

DR. CHARLES FREDERICK BURGESS, president of the C. F. Burgess Laboratories, Inc., New York City, has been awarded the Edward Goodrich Acheson Medal and $1,000 Prize by The Electrochemical Society.

THE honorary degree of doctor of letters was conferred on September 24 by Colgate University upon Dr. George D. Stoddard, formerly dean of the Graduate College and director of the Child Welfare Research Station at the State University of Iowa, now Commissioner of Education of the State of New York.

Nature reports that the medical faculty of the University of Basle has conferred an honorary doctorate on Professor Eugéne Pittard, rector of the University of Geneva, on the occasion of his seventy-fifth birthday, in recognition of his services to anthropology.

DR. G. S. WHITBY, until recently director of the Chemical Research Laboratory, Department of Scientific and Industrial Research, at Teddington, Middlesex, England, has been appointed professor of rubber chemistry at the University of Akron. For several months he has been connected with the British Raw Materials Mission in the United States.

KARL W. WOODWARD, for twenty-five years professor of forestry and head of the department at the University of New Hampshire and since 1940 consulting forester, has been appointed professor of forestry at the Massachusetts State College during the absence of Professor Robert P. Holdsworth, who is now a captain in the Army. Dr. R. E. Trippensee, professor of wildlife management, has been named acting head of the department.

CLIFFORD O. ANDERSON, of the University of Minnesota, has been appointed assistant professor of mechanical engineering at Iowa State College. Dr. Sara Kalar Merryman has been named assistant professor of hygiene.

DR. FRANK R. BLOOD, of the Haskell Laboratory of Industrial Toxicology of the du Pont Company, has been appointed assistant professor in chemistry at the University of Denver.

DR. JOSEPH T. ROBERTS, assistant professor of medicine and anatomy at the University of Texas Medical Branch, Galveston, has been appointed director of the Experimental Laboratory.

THE *Journal* of the American Medical Association reports that Dr. Alfred Cyril Callister, Salt Lake City, has been appointed dean of the School of Medicine of the University of Utah. Dr. Clay B. Freudenberger, professor of anatomy and formerly acting dean, has been appointed associate dean. Other new appointments include those of Dr. Louis P. Gebhardt, Jr., as associate professor of bacteriology and pathology and of Dr. Robert E. Hoyt as assistant professor. Dr. Gebhardt was formerly acting assistant professor of bacteriology at the School of Medicine, Stanford University, San Francisco, and Dr. Hoyt, instructor in bacteriology in the University of Minnesota Medical School.

DR. CHING CHEH, who has been acting for the past two years as consultant for the Universal Trading Corporation in New York City, has been appointed lecturer in chemistry at Bennington College, Vermont. Helen V. Crouse will lecture on biology.

DR. THOMAS R. WOOD, of the University of Illinois, and Dr. Edward M. Scott, of the University of Minnesota, have been appointed post-doctorate fellows in biochemistry at the University of Pittsburgh.

SIR HAROLD SCOTT retired on August 31 from the directorship of the British Bureau of Hygiene and Tropical Diseases which he has held since 1935. Dr. Charles Wilcocks, assistant director of the bureau, has become acting director.

DR. FRANK W. PARKER, agronomist, E. I. du Pont de Nemours and Company, Wilmington, Del., served during June and July as a consultant on fertilizer problems in the Office of Price Administration. He took part in conducting a series of regional conferences which led to reduction of the number of grades of fertilizer sold in all states, including the adjustment of the nitrogen content of fertilizers to fit the limited supply of chemical nitrogen in prospect for 1943.

DR. CLIFFORD KUH, New Haven, chairman of the committee on industrial health of the Connecticut State Medical Society, has become director of the Bureau of Industrial Health of the California State Department of Health.

FREDERICK W. SULLIVAN, JR., of the Barrett Division of the Allied Chemical and Dye Corporation, where he has been manager of chemical research since 1940, has become technical director of the Institute of Gas Technology, Chicago.

DR. ROBERT M. HEILMAN, of the U. S. Public Health Service, has been appointed head of a newly established division of the Kansas State Board of Health to provide consultant service for the industries of the state.

SARGENT RUSSELL, research assistant at Massachusetts State College since 1940, has resigned to become a member of the staff of the Agricultural Marketing Administration, Washington, D. C.

ACCORDING to *Chemical and Engineering News*, George S. Baldry, formerly connected with the Harvard School of Public Health, has been appointed director of the Division of Industrial Hygiene for the Province of Manitoba.

DR. WILLIAM BEEBE, of the New York Zoological Society, has returned to New York from a seven-month expedition in the jungles of eastern Venezuela.

Members of the expedition staff were George Swanson, staff artist; Jocelyn Crane, who helped in taking 6,000 feet of colored film; Mary VanderPyl, field associate, and Henry Fleming, entomologist. The expedition was sponsored by the Nelson Rockefeller Committee for Inter-American Intellectual Relations and the Standard Oil Company of New Jersey and Venezuela.

THE British Medical Research Council, according to *Nature*, has appointed members of its Industrial Health Research Board during the period 1942–45 as follows: The Rt. Hon. the Earl De La Warr, *chairman*, Professor F. C. Bartlett, Brigadier-General A. C. Baylay, Dr. J. C. Bridge, Dr. A. N. Drury, Dr. T. Ferguson, Dr. M. W. Goldblatt, Dr. A. Bradford Hill, Dr. Donald Hunter, Professor Esther Killick, Air Vice-marshal Sir David Munro and J. L. Smyth. Professor A. W. M. Ellis, director of research in industrial medicine under the council, will also attend all meetings. Dr. R. S. F. Schilling, a medical inspector of factories, has been seconded to the service of the Council by the Ministry of Labor to act as secretary of the board. The terms of reference of the board have recently been revised and are now as follows: "To advise and assist the Medical Research Council in promoting scientific investigations into problems of health among workers, including occupational and environmental factors in the causation of ill-health and disease, and the relation of methods and conditions of work to the functions and efficiency of body and mind, and in making known such results of these researches as are capable of useful application to practical needs."

THE *Journal* of the American Medical Association reports that "Public Health in New York City: Retrospect and Prospect" will be the subject of the first meeting on November 4 of the fall and winter series of the section on historical and cultural medicine of the New York Academy of Medicine. The meeting will be sponsored jointly by the historical section and the committee on public health relations. Topics to be discussed include "The Story of the Public and Voluntary Health Agencies" and "Glimpses into the Future." The following program has been announced for meetings of the historical section, which are held bi-monthly: Drs. Henry E. Sigerist and Arturo Castiglioni will speak on "Vesalius" on January 13, and Dr. Edward Rosen on "Copernicus," on March 10.

THE Rochester Academy of Medicine will open its series of autumn lectures on October 6, when Dr. Oswald H. Robertson, professor of medicine of the School of Medicine of the University of Chicago, will speak on "Air-borne Infections." Dr. Roy G. Hoskins, Boston, will lecture on November 3 on "The Endocrinology of To-day," and in December Dr. Fred W. Stewart, New York, will discuss "The Effect of Diet and Diet Deficiencies on the Production of Cancer."

THE forty-seventh annual meeting of the American Academy of Ophthalmology and Otolaryngology will be held at the Palmer House, Chicago, from October 11 to 14, under the presidency of Dr. Ralph I. Lloyd, of Brooklyn.

THE council of the Mycological Society of America has cancelled the annual meeting which it was planned to hold in New York on December 28, 29 and 30.

THE Department of Chemistry of the University of Pittsburgh plans to offer free evening courses for the training of individuals in chemistry for war industries. The purpose of these courses is to prepare new men and women to replace those who have entered the armed forces and to train individuals already employed in industry for more advanced chemical service. The courses planned include introductory and advanced metallurgical analysis; microscopical testing of industrial materials; electrical and optical instruments for analytical control; practical food testing and control; food and water inspection; practical vitamin assaying; industrial quantitative organic analysis. An elementary course on chemical fundamentals for war workers is also planned to prepare individuals for the more advanced practical courses which are listed above. A descriptive bulletin of courses may be obtained by writing to Dr. Herbert Spencer, regional coordinator of engineering, science and management, war-training courses, Pennsylvania College for Women, Pittsburgh, Pa. Fall courses will begin on October 12, and registration will take place during the preceding week.

ACTING on the suggestions made by Government and military officials at the Institute on Education and the War recently held in Washington, the New York University College of Arts and Pure Science at University Heights inaugurated an optional first year academic program beginning on September 21 to train undergraduates for active participation in the war effort. The special curriculum includes general physics; trigonometry and college algebra; the preparation and interpretation of military maps and military geology; hygiene and sanitation; French, Spanish, military German or scientific German; English composition emphasizing clarity and precision of expression; a course in speech which will include the methodology of command and proficiency in oral exposition, and the basic course in military science and tactics offered under the Army's Reserve Officers' Training Corps. The curriculum is designed for those students who are not preparing for medicine, dentistry, chemistry or other fields heretofore recognized as critical occupations.

ACCORDING to *Museum News*, Miss Caroline Hazard, honorary president of the Santa Barbara Museum of Natural History, has given the museum an additional piece of property and endowment that will cover upkeep of the new gift and perpetuate her annual subscription to the museum's funds. The land is across the street from the museum and will be used for a residence for the director and for laboratories and work rooms. It consists of ten lots, approximately 300 feet square fronting on Mission Canyon Road. There is a California redwood house on the property.

THE *Times*, London, states that at a meeting on September 8 of the British Parliamentary and Scientific Committee, the recent appointment of three full-time scientific advisers to the Ministry of Production was considered and the following resolution was passed: "This committee, while welcoming the appointment of three full-time scientific advisers to the staff of the Ministry of Production in so far as it establishes the nucleus of a central scientific and technical board, regrets that their field of activity is apparently to be limited to the sphere of production and does not include the scientific and technical activities of the service departments or the other ministries outside the strict field of production. An extension of its functions is needed to ensure that all scientific considerations are coordinated and given full weight over the whole field of the national effort. The committee considers, therefore, that in order to cover this wider field, scientific advisers should have direct access to the War Cabinet and that accordingly the Lord Privy Seal should exercise his supervisory functions over the new body directly on behalf of the War Cabinet." It was reported that 126 members have now added their names to the motion on the Order Paper, which suggests that "present circumstances require the early establishment of a whole-time Central Scientific and Technical Board to coordinate research and developments in relation to the war effort."

DISCUSSION

VERTICAL ORIENTATION OF POWDERY MILDEW CONIDIA DURING FALL

HYDRODYNAMIC theory[1] indicates that flattened or elongated objects fall with the surface of greatest resistance normal to the direction of motion. From extensive observations of the fall of spores of Basidiomycetes and inert objects Buller[2] confirmed this and stated the general principle that "Any homogeneous elongated body falling in still air tends to orientate itself in such a way as to present the maximum amount of surface in the direction of the line of fall and thus fall as slowly as possible." The fall of powdery mildew conidia in a vertical position and in apparent disagreement with the above-stated principle is therefore of interest.

Conidia of *Erysiphe graminis* D.C. grown on barley plants in the greenhouse were mostly used, but limited observations of *Erysiphe polygoni* D.C. indicate that other powdery mildews may behave in a similar manner. Conidia of *E. graminis* are one-celled, ellipsoidal, symmetrical, 13×32 microns, with smooth walls, do not collapse during several hours of drying, have a large central nucleus and fall at approximately 1.2 cm per second in air. They are therefore much larger, and differ in several other important respects from the basidiospores studied by Buller. When caught on glass slides under field or greenhouse conditions most conidia are in a horizontal position with respect to the surface of the slide. However, when caught on glass slides after falling through a glass tube, many conidia are vertical on the slides, and the vertical conidia have fallen at a faster rate than the horizontal conidia. Many of the conidia also fell in a vertical position when suspended in water in a glass tube.

To determine whether the conidia actually fall in a vertical position in air or if the vertical orientation on the slides is an end effect, they were observed and photographed during fall in a glass tube with inside dimensions of 77×0.7 cm by means of a horizontal microscope. Dark-field illumination was obtained from a commercial adaptation of the Edgerton flash apparatus.[3] With intermittent flashes (30 times a second) and with a magnification of about one hundred diameters, it was easily possible to determine the orientation of every spore in focus during fall. Of 403 conidia clearly observed, 204 were vertical and 199 were horizontal. An average of two spore images per photograph was obtained when each frame was exposed with 50 microsecond flashes about ten times during a spore fall period. Of 65 single conidia photographed during fall, 34 were vertical and 31 horizontal. In the direct observations and in the photographs all conidia in focus were readily classified as vertical or horizontal and no conidia with intermediate orientation were found, indicating that the falling spores assume one or the other of these two apparently stable positions. With the same tube and with other conditions similar, but catching the conidia on slides, 307 out of 600 were classified as vertical and 293 as horizontal. On the slides some conidia were

[1] W. Thomson and P. G. Tait. "Treatise on Natural Philosophy." Article 333, 1867, Clarendon Press, London.

[2] A. H. Reginald Buller. "Researches on Fungi," II, 35, 1922. Longmans, Green and Company, London.

[3] General Radio Company, Type 648–A Strobolux.

leaning and were difficult to classify as vertical or horizontal. The similarity in the data from these three methods would indicate that for most purposes observation of position after fall is a fairly reliable index of position during fall, and that many powdery mildew conidia actually fall with their long axes in a vertical position. Reduction of convection currents is probably an important function of the tube in causing a high percentage of vertical orientation of the conidia and in one test using a narrower tube than the above, all the conidia were found in a vertical position.

Possible explanations for vertical orientation of falling objects are displacement of the center of gravity, rotation about the axis of symmetry and lateral friction due to close approach to the wall of the enclosing container. It has not been determined to what extent any of these could apply to mildew conidia but the writers believe that slight and not clearly observed displacement of the nucleus and vacuoles from a symmetrical arrangement within the spore might account for its vertical orientation under the conditions of the confined air of the small glass tubes.

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THE REQUIREMENTS OF PARASITES FOR MORE THAN HOSTS

THE introduction from abroad of beneficial parasites for the control of injurious insect pests may attain even greater success if *all* factors essential to the optimum development of the parasite are studied. For too long the entomologist has centered his attention on the beneficial parasitic stage of the parasite, often failing to appreciate the equal importance of the remainder of its life-history.

Some parasites attack their host in all their active stages, as in the case of the Australian lady-beetle, *Rodolia* (*Novius*) *cardinalis,* which feeds as both larva and adult on the cottony cushion scale, *Icerya purchasi.* Any climatic conditions suitable to the host are equally favorable to its specific predator, with no additional factors necessary, and to this is largely due its outstanding success when introduced originally into California, and later in every other country where the cottony cushion scale has appeared.

This is really the very simplest type of parasite introduction, and the comparative ease with which its success was attained gives little indication of the complications attending that of other kinds of parasites. Most of these attack their insect host either as a larva or as an adult, but not as both, and require some additional factor for survival in their non-parasitic stage. No organism can survive in a new environment where any individual factor essential to its existence is lacking. It is the neglect of this principle, which may be considered almost a biological axiom, that in many cases has prevented other parasites from becoming equally effective in the control of their specific injurious host. The following examples, from the personal experience of the writer, have a more than local application.

The successful introduction into Puerto Rico from Brazil of a large wasp, *Larra americana* Saussure, which is parasitic in its larval stage on a mole cricket, the Puerto Rican "changa," *Scapteriscus vicinus* Scudder, apparently depended on the presence in Puerto Rico of two weeds, locally known as "botoncillo," *Borreria verticillata* and *Hyptis atrorubens,* from the flowers of which only do the wasps obtain nectar. Where these weeds were continuously present in abundance in Puerto Rico, *Larra* became established; where they were scarce or absent, even though changas were present in abundance, the wasps failed to survive. It is possible that some other minor factors may in part have been responsible, but we are not aware of them, and the experiment seems to check as well as one can hope in introductions of this kind.

Instances where there is no successful introduction, but only a series of unexplained failures, are much more numerous, and of these only a single instance need be cited. Repeated attempts to establish the Scarabaeid dung-beetle, *Canthon violaceus* Olivier, of Hispaniola in Puerto Rico were made in 1913, and again more recently. The beetles thrive in captivity, and hundreds of the progeny of those originally brought from across the Mona Passage have been released in Puerto Rican environments that would appear to be identical with those in Hispaniola, yet not one has since been found alive in all the years following. The life-history of these scarabs is apparently so simple that we can not see that anything essential is lacking in Puerto Rico that is present in their country of origin, but it must be so, otherwise how explain their failure to survive.

More instructive are instances of abundant and effective parasites which fail to become numerous elsewhere. Throughout the world, white grubs are attacked by wasps of the genus *Tiphia,* which are often an important factor in control. In Puerto Rico, where endemic white grubs became very numerous and were the major pest of all agricultural crops, admittedly *Tiphia* wasps do exist, but are so scarce that not enough specimens have been collected so that specialists can be sure of their specific identity. In Hispaniola, *Tiphia* is abundant, and along the coast is often collected feeding on the sweet secretions of scale

insects and whiteflies. Most of the collections of *Tiphia* in Puerto Rico were made under similar conditions, but in Haiti *Tiphia* is much more often seen frequenting the flowers of wild parsley, *Pastinaca sativa*. At the lower elevations in Puerto Rico, wild parsley does not attain maturity, and even in the mountains must be planted and cared for if one is to have a continuous supply of flowers. At Kenscoff and elsewhere in Haiti, it is a weed that no amount of cultivation seems to discourage. With wild parsley flowers present in abundance at all seasons of the year, *Tiphia* wasps thrive in Haiti, yet barely manage to survive in Puerto Rico, feeding on the excretions of scale insects. The presence or absence of this one factor, important but admittedly not absolutely vital to the non-parasitic stage of their major parasite, apparently determined the relative abundance of white grubs in these two countries.

The coffee leaf-miner, *Leucoptera coffeella*, appears to be present everywhere that Arabian coffee grows, and has numerous minute wasp parasites, generally of very minor importance in its control. On the island of Guadeloupe, French West Indies, Mr. F. Sein found a Braconid parasite, later named *Mirax insularis* by Mr. C. F. W. Muesebeck, which attacks from 65 to 80 per cent. of all the leaf-miner caterpillars. Introduced into Puerto Rico, it has become established, but rarely can one find more than a fraction of 1 per cent. of parasitization. What factor, present in the coffee groves of Guadeloupe, is so scarce in Puerto Rican groves that this parasite, so effective there, can not attain a similar fortunate destiny in Puerto Rico?

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THE COMPLETE UTILIZATION OF SCIENTIFICALLY TRAINED PERSONNEL

IN his recent communication[1] on "Wartime Scientific Manpower Production" Professor Nicholas deals with one phase of a problem which has caused, as he says, "the growing demand for complete utilization of scientifically trained personnel." Scientific teaching which is designed to train new personnel in fields where shortages exist or are imminent furthers the war effort and should therefore be considered as an important duty, as well as an essential war job. There are several other ways through which existing personnel shortages in the various fields of physics could be alleviated. There are many workers in the biological, chemical and geological fields who have the qualifications either for teaching or for war research in physics and who are not as yet doing war work. New teaching personnel could also be found in the ranks of the refugee scientists who are barred from war research because they are non-citizens. Many high-school science teachers are well qualified to teach college courses. In addition, a system for exchange of teaching personnel, such as is already being used by some institutions, could make more teachers available by increasing the efficiency of their utilization.

The above suggestions supplement Professor Nicholas's suggestion of a "personal inventory" with the proposal that the National Roster, or another qualified body, make an inventory of various groups of people who are available to fill the deficit in teaching and research personnel in those fields where shortages exist or are imminent. But it is in relatively few fields that the needs of war research have thus far made a serious drain on scientific manpower. In the field of biology, including the medical and agricultural sciences, and in chemistry mobilization is far from complete. It is chiefly this fact which has caused "the growing demand for complete utilization of scientifically trained personnel," and it was with this phase of the problem that an earlier communication from the American Association of Scientific Workers was concerned. Since the publication of this communication,[2] the AAScW has sent a memorandum (July 30) to the National Academy of Sciences and a letter (Aug. 27) to Dr. Vannevar Bush, the director of OSRD, containing recommendations for specific actions by these two bodies which would aid the mobilization of scientific personnel.

The bottleneck in the full utilization of scientists in the fields mentioned appears to be the difficulty of converting their peacetime research into activity fruitful to the war effort.[3] Many of the war problems in these fields are not obvious to the civilian scientist. Many scientists are therefore awaiting the time when the national scientific authorities will call upon them for specific work. They do not often realize the magnitude of the task which is being done so well by our scientific authorities and many have become discouraged because of the delay in calling upon them for war work. There is hesitation about formulating research projects independently and a paucity of means by which individual or group initiative can be encouraged and made effective. It is feared that independently formulated projects may duplicate work actively in progress and that such independently initiated projects are not wanted by our scientific authorities. Many scientists do not realize that they can themselves make important pioneering contributions to war problems because of their specialized

[1] SCIENCE, 96: 2484, 135–6, August 7, 1942.

[2] *Ibid.*, 96: 2479, 16, July 3, 1942.

[3] This difficulty is not unique for our country but also exists in Great Britain, as can be seen from various editorials in *Nature* and from reports on this question by our colleague, the British Association of Scientific Workers, *e.g.*, *Nature*, No. 3797, August 8, 1942, pp. 186–8.

knowledge of new techniques and of the latest developments in their own fields.

The general solution to the problem of the utilization of scientists has been well stated by Professor Wilder Penfield,[4] who speaks from his experience as a participant in the Canadian and British war effort. In Professor Penfield's words: "It should be recognized as a principle in a democratic country that the government can not be considered omniscient, or always wise. Leadership must therefore develop spontaneously in every department of our national life. New ideas and new efforts should break out among men in all walks of life, from laborer to industrialist and professor, like an epidemic of influenza."

The American Association of Scientific Workers, through several of its branches, is developing activity to aid scientists in formulating and presenting projects for war research. This small-scale experiment is sufficiently promising that it is being paralleled by other groups. The extension of such activity throughout the country appears desirable and the AAScW has recommended to our national authorities various steps which will encourage and promote the exercise of their creative initiative by our civilian scientists so that new problems and new types of research useful to the war effort may arise on the basis of peacetime skills.

HARRY GRUNDFEST,
National Secretary, American Association of Scientific Workers

SCIENTIFIC BOOKS

ORGANIC CHEMISTRY

Organic Reactions. Vol. I. ROGER ADAMS, editor-in-chief; WERNER E. BACHMANN, LOUIS F. FIESER, JOHN R. JOHNSON and H. R. SNYDER. Pp. vi + 391. New York: John Wiley and Sons, Inc.; London: Chapman & Hall, Ltd. 1942. Price, $4.00.

THIS is the first volume of a publication which it is hoped to issue periodically in books of about 12 chapters each, under the general editorship of Dr. Roger Adams, an editorial board and a group of associate editors. The editorial group and the contributors of the individual chapters are all recognized leaders in their chosen fields, on both the experimental and the literary sides. The result, as was to be expected, is an admirable piece of work, constituting an exceptionally valuable contribution to the literature of organic chemistry.

Every investigator, in the prosecution of his experimental laboratory work on synthetic organic chemical problems, draws upon our accumulated knowledge of chemical reactions as stored up for him in texts and reference books. Space limitations prevent the inclusion in such books of adequate discussion of the scope and limitations of these reactions, of the conditions determining maximum yields or of giving specific illustrative examples of variations in technic. The investigator, therefore, may have to spend a large amount of valuable time in searching the literature for this information. The purpose of the present undertaking is to meet this need, and all organic chemists will be grateful to those who are carrying through this project.

This first volume consists of 12 chapters, each devoted to a single reaction, or a definite phase thereof, as follows: (1) Reformatsky Reaction; (2) Arndt-Eistert Synthesis; (3) Chloromethylation of Aromatic Compounds; (4) Amination of Heterocyclic Bases by Alkali Amides; (5) Bucherer Reaction; (6) Elbs Reaction; (7) Clemmensen Reduction; (8) Perkin Reaction; (9) Acetoacetic Ester Condensation; (10) Mannich Reaction; (11) Fries Reaction; (12) Jacobsen Reaction. These subjects are presented from the preparative view-point, and the authors have had practical personal experience with the processes described. Each chapter begins with a Table of Contents, lists in tables the different compounds to which the reaction has been applied and includes full references to the literature. The book is indispensable to every investigator of synthetic organic chemical problems.

As it is practically impossible, in gathering data of this kind, not to miss some facts of interest buried in unexpected places, one way in which organic chemists can express their appreciation to the authors of this and subsequent volumes is to call their attention to any omissions they may note. Cooperation in this direction, the reviewer is confident, will be both welcome and helpful.

As is always the case with Wiley publications, paper, presswork and binding are admirable.

Organic Syntheses. Vol. 22. An Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. LEE IRVIN SMITH, editor-in-chief, with an editorial board and an advisory board. Pp. 114. New York: John Wiley and Sons, Inc.; London: Chapman & Hall, Ltd. 1942. Price, $1.75.

THE new volume of this very useful series describes the preparation of the following: Acetobromoglucose;

[4] "Some Problems in Wartime Neurology," *Arch. Neurol. and Psychiat.*, May, 1942.

9-Aminoacridine; 2-Amino-*p*-cymene; *alpha*-Aminodiethylacetic acid; 2-Amino-6-methylbenzothiazole; 3-Amino-2-naphthoic acid; *dl-alpha*-Aminophenylacetic acid; *dl-beta*-Amino-*beta*-phenylpropionic acid; Azobenzene; *o*-Carboxyphenylacetonitrile; 4,4′-Diaminodiphenylsulfone; 2,6-Dimethoxybenzonitrile; 2,3-Dimethylanthraquinone; 2,3-Dimethylbutadiene-1,3; 2,5-Dinitrobenzoic acid; 3,5-Dinitrobenzoic acid; Diphenylacetylene; Diphenyliodonium iodide; *beta*-Gentiobiose octaacetate; *beta-d*-Glucose-1,2,3,4-tetraacetate; Guanidoacetic acid; Homophthalic acid; 2-Hydroxy-1-naphthaldehyde; Imidazole; Iodobenzene dichloride; Iodosobenzene; Iodoxybenzene; Linoleic acid; Linolenic acid; *d*-Mannose; N-Methyl-3,4-dihydroxyphenylalanine; 2-Methylindole; Phenyl azide, 2-Phenylindole.

As usual, these preparations have been checked by other chemists in addition to those who sent them in, and are accompanied by pertinent explanatory notes and numerous references to the literature. It is noteworthy that the contributors are not limited to our own country, but include also chemists from Canada, Australia, South America and other lands. The cumulative subject index covers Volumes 20, 21 and 22.

An Outline of Organic Nitrogen Compounds. By ED. F. DEGERING, CARL BORDENCA and B. H. GWYNN, with the cooperation of 21 collaborators and many graduate students. Third edition (previous editions 1938 and 1940). 381 pp. Planographed by John S. Swift Company, Inc., Cincinnati, Ohio. May, 1942. Price, $6.

THIS is the first planographed edition of the notes which the author has accumulated and digested during ten years of lecturing in this field to graduate students. As the title states, the book is intended to be only an outline of the subject, and does not aim to be complete either in its coverage of all classes of organic nitrogen compounds or in the details supplied for those classes which are included. So far as the reviewer is aware, it is the only book available which deals with the subject in just this way, and should be very helpful to students, research workers and specialists. Although presented only in outline, briefly, compactly and concisely, the information supplied is very considerable and clearly intelligible.

The arrangement of the subject-matter is, on the whole, logical, beginning with General Concepts, the Fixation of Atmospheric Nitrogen and the Ammonia System of Compounds, then taking up nitro, nitroso, oximino, amino, etc., derivatives, aliphatic and aromatic alkaloids and nitrogen heterocycles, etc., although the reviewer might raise the question whether the Isomerism of the Organic Nitrogen Compounds, instead of being the last chapter in the book, might not better appear much earlier. A separate chapter on Explosives is timely and instructive. Bibliographies and references to the literature are numerous and add greatly to the value of the work. Both author and subject indexes are provided. The book is cordially recommended.

Organic Chemistry. By REYNOLD C. FUSON and H. R. SNYDER. 506 pp. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1942. Price, $3.50.

As the authors state in the preface, this book aims to cover the ground required of students in the courses known as Chem. 34 and Chem. 36, which together cover the first year's work in organic chemistry at the University of Illinois, where they have been given for many years.

Chem. 34, represented by Part I, consisting of Chapters I to XVIII inclusive, is an initial course. It gives the student a bird'e-eye view of the general field of organic chemistry and familiarizes him with the principal classes of organic compounds.

Chem. 36, as set forth in Part II, Chapters XIX to XXXIV inclusive, likewise covers the general field of organic chemistry, but with more emphasis upon details and especially upon the use of standard reactions in synthesis. This Part II has been found useful by graduate students as a survey and review course and in preparation for Ph.D. examinations.

Manifestly, this method of presentation involves a certain amount of repetition but, in the opinion of the authors, this is distinctly advantageous.

At the end of most of the chapters, "Problems and Suggested Readings" are given, and at the close of the book, in addition to the index, Appendix A discusses "Nomenclature and Pronunciation," and Appendix B gives an extensive list of additional "Problems and Questions for Review."

A praiseworthy feature of Part II, in emphasizing important reactions, is the association therewith of the names of the chemists by whom they were discovered or developed. The student thus becomes acquainted with some of the builders of the vast edifice of organic chemistry. Another useful feature is the attention given to the industrial applications of the experimental facts recorded.

The book constitutes an admirable first-year course, lucidly and logically presented, up to date, and is a good illustration of the excellent instruction given in this field at the University of Illinois. Paper, presswork and binding are first-class.

MARSTON TAYLOR BOGERT

SPECIAL ARTICLES

BIOTIN DEFICIENCY AND OTHER CHANGES IN RATS GIVEN SULFANILYLGUANIDINE OR SUCCINYL SULFATHIAZOLE IN PURIFIED DIETS

THERE is general agreement[1, 2, 3, 4] that sulfaguanidine (sulfanilylguanidine), added to a purified diet, reduces the growth rate of young rats. Similar results have been reported[4, 5] for sulfasuxidine (succinyl sulfathiazole). It has been suggested[1, 5] that the reduced rate of growth might be explained on the basis of suppression by the drug of intestinal synthesis of essential growth factors. It has been further suggested[4] that these sulfonamide drugs might exert a part of their effect by interference with the action, in the animal body, of one or more essential enzyme systems. If sulfaguanidine and sulfasuxidine act through either or both of these mechanisms, then it should be possible to produce characteristic deficiency syndromes, the development of which might be prevented, individually, by the use of small amounts of pure substances or concentrates.

In this laboratory, we have observed the following changes in rats given sulfaguanidine or sulfasuxidine in purified diets. First, hyaline sclerosis and calcification of blood vessels[6]; second, agranulocytosis, leukopenia, bone marrow aplasia and, occasionally, anemia[4]; third, hyalinization, necrosis and calcification of voluntary muscle[7]; and fourth, a dermatitis which can be prevented or successfully treated with biotin. We have also observed necrosis of heart muscle, hemorrhage into various organs and subcutaneous tissues, and liver damage.

In our work with the sulfonamide drugs we have to date employed variations of a single basic diet. This basal diet consists of glucose ("Cerelose") 73 per cent., leached and alcohol extracted casein 18 per cent., cod liver oil 2 per cent., cottonseed oil (Wesson oil) 3 per cent. and salt mixture 4 per cent. The drug at a level of 1 per cent. has been included at the expense of an equivalent amount of glucose. Each rat has been given a daily supplement of 100 micrograms of thiamine, 200 micrograms of riboflavin, 100 micrograms of pyridoxine, 200 micrograms of calcium pantothenate, 1 mg of niacin and 10 mg of choline chloride.

Thirty rats receiving sulfaguanidine and 10 receiving sulfasuxidine have been kept on this régime until their deaths. Twenty additional rats receiving one or the other of these drugs have been given a daily supplementary feeding of 0.05 cc of an impure biotin concentrate,[8] beginning after growth of these animals had ceased; 35 others have been given, similarly, 40 to 100 mg of a liver extract[9] daily.

Of the 40 rats given neither biotin concentrate nor liver extract, only 2 have survived longer than two months. Examination of the blood of 22 of these rats shortly before death revealed an agranulocytosis and a leukopenia and, less frequently, an anemia.[4] Histological examination revealed some degree of bone-marrow aplasia in 16 of 18 marrows examined,[4] a hyalinization, necrosis or calcification of voluntary muscle in 12 of 15 rats examined for this condition,[7] but blood vessel changes in only 5 of the 29 of these rats examined to date.[6] Any degree of biotin deficiency present in these animals was difficult to diagnose.

The use of the biotin concentrate has proved to be of value in the routine development of the blood vessel changes. Of the 20 rats given 0.05 cc portions of this concentrate, 11 have survived for 2 months or longer and 3 have lived for more than 3 months; 13 of these 20 animals have been examined histologically to date; 11 of these 13 have shown hypocellularity of bone marrow, 12 have shown muscle hyalinization and necrosis, and 10 have shown calcification of blood vessels.

The use of the liver extracts has been of particular value in the development, in a mild form, of the characteristic dermatitis of biotin deficiency. No attempt has been made to determine the span of life of these animals, but of the 35 rats used in this phase of the work, 33 have been kept on experiment for 3 months or longer. The dermatitis has developed very slowly but has been noted in 24 of the 35 animals. It is similar in appearance to that produced by raw egg white but does not attain the same severity.[10] Remission of symptoms has occurred in all 10 animals which were given crystalline biotin[11] orally or parenterally in daily doses of 0.5 to 10 micrograms for 14 days.

[1] S. Black, J. M. McKibbin and C. A. Elvehjem, *Proc. Soc. Exp. Biol. and Med.*, 47: 308, 1941.

[2] J. B. Mackenzie, C. G. Mackenzie and E. V. McCollum, SCIENCE, 94: 518, 1941.

[3] W. J. Dann, *Jour. Biol. Chem.*, 141: 803, 1941.

[4] S. S. Spicer, F. S. Daft, W. H. Sebrell and L. L. Ashburn, Prevention and Treatment of Agranulocytosis and Leukopenia in Rats Given Sulfaguanidine or Succinyl Sulfathiazole in Purified Diets, *Pub. Health Rep.* (in press).

[5] A. D. Welch, *Federation Proceedings*, Part II, Fed. of Amer. Soc. for Exper. Biol., Vol. 1, p. 171, March 16, 1942.

[6] F. S. Daft, L. L. Ashburn, S. S. Spicer and W. H. Sebrell, *Pub. Health Rep.*, 57: 217, 1942.

[7] F. S. Daft, L. L. Ashburn and W. H. Sebrell. Unpublished results.

[8] S.M.A. No. 1000.

[9] Eli Lilly's No. 343 or Lederle's 80 per cent. alcohol insoluble.

[10] The results of microbiological assays indicate the following approximate figures for the biotin content of these liver extracts: Lilly's No. 343 1.5 micrograms per gram; Lederle's 80 per cent. alcohol insoluble 0.06 micrograms per gram. We are indebted to Dr. Roy Hertz for these assays.

[11] Supplied through the courtesy of Dr. Hans Molitor, Merck Therapeutic Institute.

SUMMARY

The following pathological changes have been observed in rats given sulfaguanidine or sulfasuxidine in purified diets.

1. A granulocytopenia, leukopenia, hypocellularity of bone marrow and, occasionally, an anemia.

2. Hyalinization, necrosis and calcification of voluntary muscle.

3. Hyaline sclerosis and calcification of blood vessels.

4. A dermatitis which can be prevented or successfully treated with crystalline biotin.

We have also observed necrosis of heart muscle, hemorrhage into various organs and subcutaneous tissues, and liver damage.

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ATYPICAL RESPONSE OF THE RABBIT TO DESOXYCORTICOSTERONE ACETATE

WE have found[1,2] that administration of desoxycorticosterone acetate, progesterone, alpha-estradiol benzoate, testosterone proprionate and diethylstilbestrol to dogs results in a marked increase in the rate of entrance of Na and Cl into 5.5 per cent. dextrose solution introduced into the peritoneal cavity. No such effect was noted in rabbits following administration of desoxycorticosterone acetate, progesterone and diethylstilbestrol.[2] Certain additional findings are of interest in this connection.

Injection of 2.5 mg of DOCA daily for three days in two rabbits had no significant influence upon the urinary excretion of water or Cl during the experimental period. Two rabbits (2.0 and 1.8 kg) received 2.5 mg of DOCA daily for three months, the animals being weighed and the blood-pressure determined[3] bi-weekly. There was no significant change in weight for six weeks in one animal and eight weeks in the other, with a subsequent increase to a maximum of 47 and 40 per cent., respectively, over the pre-treatment levels at the end of the experimental period. There was no significant alteration in blood-pressure and no edema or other evidence of toxic effect of DOCA, as has been reported in the dog.[4] Two pregnant rabbits treated in the same manner showed no significant gain in weight, no edema and no increase in blood-pressure. Both aborted at about four weeks' gestation, one developed marked weakness of the hind limbs after five weeks of treatment and both died after six weeks. The weakness of the hind limbs may have been due to decrease in the serum K concentration; the serum Cl concentration was unaltered in the non-pregnant animals, but no chemical studies were performed in the pregnant rabbits. Dexter and Weiss[5] have reported a similar absence of effect of large doses of DOCA in pregnant and non-pregnant rabbits in experiments of shorter duration.

These observations suggest the existence of a marked species difference in the influence of DOCA and perhaps also progesterone, estradiol, testosterone and other steroid hormones upon water and electrolyte metabolism. This has an important bearing, perhaps, on the use of the rabbit in studies of the relation of these hormones to hypertensive "toxemia" of pregnancy.

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[1] A. Cantarow and A. E. Rakoff, *Endocrinology*, 27: 652, 1940.

[2] A. E. Rakoff and A. Cantarow, *Endocrinology*, 30: 816, 1942.

[3] R. I. Grant and P. Rothschild, *Jour. Physiol.*, 81: 265, 1934.

[4] D. Kuhlmann, C. Ragan, J. W. Ferrebee, D. W. Atchley and R. F. Loeb, SCIENCE, 90: 496, 1939.

UNIFORMITIES IN THE CONTENT OF B VITAMINS IN MALIGNANT NEOPLASMS

FOR two years[1] this laboratory has been interested in the possibility that cancer tissues might show peculiarities in vitamin distribution, characteristic of this type of growth. We have now completed an extensive series of determinations of eight B vitamins not only on various types of human, rat and mouse cancer material but also upon normal tissues from these same animals. This material is now in press.[2]

By analysis of the values obtained, highly interesting and important uniformities are observed which we wish to set forth briefly here. We shall use the term "vitamin uniformity" to designate the similarity of vitamin content in a group of tissues. For example, if in a number of samples of muscle tissue pantothenic acid had a mean level of 5 γ per gram with a standard deviation of 1, then $1/5 \times 100$, or 20, would equal the average deviation from the mean in per cent., or, to express the relationship in the opposite manner, there would be an average degree of uniformity in pantothenic acid content of 80 per cent. The average of the "vitamin uniformities" in a series of tissues calculated for the individual vitamins is designated the "Total B Vitamin Uniformity."

[5] L. Dexter and S. Weiss, "Preeclamptic and Eclamptic Toxemia of Pregnancy." Boston: Little, Brown and Company, 1941.

[1] R. J. Williams, SCIENCE, 92: 579, 1940.

[2] University of Texas Publication 4237, 1942.

It has been found (Table I) that normal tissues of the same type but taken from separate animals, such as myocardium from different hearts, have a relatively high "total B vitamin uniformity" (70 per cent. or more), while normal tissues which differ from each other in structure and function have a relatively low degree (less than 30 per cent.) of "total B vitamin uniformity" when compared with each other.

TABLE I

VITAMIN UNIFORMITY IN NORMAL AND CANCER TISSUES

Tissues	"Total B Vitamin Uniformity" in per cent.
Human Tissues	
8 diverse normal tissues	27
Myocardium from three separate hearts*	71
8 diverse cancer tissues	66
Normal mammary, ovarian and renal tissue	11
Mammary, ovarian and renal carcinoma	60
Rat Tissues	
8 diverse normal tissues	30
Myocardium from three separate hearts*	75
5 diverse cancer tissues	63
2 hepatomas	78
2 hepatomas with corresponding adjacent liver tissues	22
Mouse Tissues	
Myocardium from three separate hearts*	76
12 diverse cancer tissues	58
Human, Rat and Mouse Tissues	
Myocardium from three human, three rat and three mouse hearts	61.2
8 human, 5 rat and 9 mouse cancer tissues of diverse origins and sites	58.8

* Individual tissues other than the heart from different specimens (in human, rat and mouse) also show high "total B vitamin uniformity" but are not included in this table.

Examination of the tumor material in this manner disclosed that malignant tumors which differed from each other in tissue of origin, manner of induction and host species tended to have a relatively high "total B vitamin uniformity" when compared with each other.

Since in our observations on normal tissues a relatively high degree of "total B vitamin uniformity" has been found to be associated only with homogeneous and never with heterogeneous groups of tissues, it is concluded that malignant neoplasms of various types and from various animals tend to have similar cellular metabolism, forming in effect a common tissue type.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE DETERMINATION OF BLOOD VOLUME WITH RED BLOOD CELLS CONTAINING RADIOACTIVE PHOSPHORUS (P^{32})[1]

THE red cell, rather than the plasma component of the blood, has several advantages in determining blood volume. First of all, the fluid portion of the blood, because of its physiological connection with tissue, lymph and other fluid spaces, is not so anatomically delimited as that containing red cells. Secondly, changes in capillary permeability affect the plasma much more frequently and markedly than the red cells. Third, the dyes used to measure plasma volume, because of diffusion and adsorption, may themselves behave differently from the plasma they are supposed to measure.

Total red cell volume has been measured by the carbon monoxide method, which, however, has not achieved acceptance for a variety of reasons. More recently, blood volume methods have been described using red cells containing radioactive iron[2] and radioactive phosphorus.[3] Though radioactive iron has a long half-life and remains in the red cells for long periods it has a serious practical disadvantage of emitting such soft radiation that direct measure of the radioactivity of the blood is technically difficult and requires more or less complicated chemical manipulations. On the other hand, radioactive phosphorus, though its half-life is but 14 days, emits energetic beta particles which enables red cells containing it to be measured more easily. Nevertheless, in the phosphorus method described by Hahn and Hevesy[3] chemical extraction of the red cells was necessary; moreover, a large amount of blood (50 cc) was used for the extraction.

In the technic to be described herein, but two cc of blood were used and they were measured directly in the Geiger counter without any chemical manipulation whatever. A donor dog was prepared by the subcutaneous injection of sodium phosphate containing radioactive phosphorus. The dose was 0.4 millicuries (P^{32}) per day for 10 days. After several days the red cells became so intensely radioactive that the blood could be diluted 100 times and yet give a sufficiently high count for accurate measurement. Washing the cells in saline several times and suspending in saline for 24 hours resulted in very little loss of activity. For the determination of blood volume 10 cc or more of the donor dog's blood was heparinized, centrifuged and the plasma (which also contains radioactive phosphorus) removed. The cells were resuspended in

[1] Aided by a grant from the Commonwealth Fund.
[2] P. F. Hahn, J. F. Ross, W. F. Bale, W. M. Balfour and G. H. Whipple, *Jour. Exp. Med.*, 75: 221, 1942.
[3] L. Hahn and G. Hevesy, *Acta Physiol. Scand.*, 1: 3, 1940.

saline and a carefully measured amount (1 cc/Kg) injected into the dog whose blood volume is to be measured. After allowing a variable time for mixing, a sample was removed, its radioactivity measured directly and compared with that of the sample injected. The blood volume was a simple matter of division. To determine red cell and plasma volume, the hematocrit provided the necessary relationship for the calculation.

We determined the radioactivity of the recipient dog's blood at various intervals after the injection in order to determine whether there was a curve of disappearance as there is with the dye method; we found no loss of activity for several hours which was more than long enough for thorough mixing. However, a slight but increasing loss of P_{32} from the red cells was observed thereafter, confirming previous observations of Hahn and Hevesy.[3,4] In this respect radioactive phosphorus presents a disadvantage over radioactive iron which, as already mentioned, remains for a long time within the red cell. On the other hand, for ease and simplicity, the method here described enables a determination to be made on one single sample of blood from the dog to be tested and but two direct determinations of radioactivity on the Geiger counter. Incompatibility of donor and recipient, though rare, will make the test valueless because of hemolysis. Our results confirm those of Hahn *et al.*,[2] in that the blood volume as determined in the above-described method is lower than that obtained by simultaneous determinations with the blue dye (T–1284). Additional details will be described later.

The authors are indebted to Dr. John H. Lawrence for supplying the radioactive sodium phosphate and to Dr. Carl Moore for the Geiger counter used in these experiments.

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FREEZING MYRIAPODS FOR PHOTOGRAPHING

PHOTOGRAPHING small myriapods, such as pauropods 1.5 mm in length, presents many difficulties. Distortion especially is pronounced when they are inactivated or killed. The application of anesthetics such as ether, chloroform, chloretone, etc., to immobilize them was not found satisfactory because of ensuing contraction and distortion. Specimens preserved in alcohol or formaldehyde were likewise found to be misshapen.

Slow killing in a sealed moistened cell chamber mounted on a glass slide was tried. By applying heat from a 60-watt bulb at a distance of 6 to 8 inches, the specimens became immobile in a few minutes. This procedure partially solved the problem of getting the desired relaxation but was discontinued when found to be rather erratic.

Finally, quick freezing was tried and found successful. A small glass circular cell was placed on an ordinary glass slide and the bottom covered with thick, black absorbent paper or a mixture of 3 parts plaster of Paris and 1 part powdered animal charcoal. Moisture was added, live specimens placed within, and the cell sealed with a cover slip. The specimens were then exposed to a temperature of $-12°$ C for about 25 minutes which killed them and at the same time preserved a nearly normal appearance.

A fixed focus camera used with a compound microscope was prepared ahead of time. For our set-up it was found satisfactory to use a Bausch and Lomb surface illuminator. When the specimens were ready they were taken from the freezing chamber and immediately photographed. If desirable the cover slip may be removed during exposure and replaced immediately after to prevent drying. Thus, the same specimen may be used more than once. With the light source at our disposal it was found best to keep exposure time ½ second or less, since a longer period tended to curl and dry the specimens. This freezing method should be equally applicable in photographing other small organisms.

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BOOKS RECEIVED

BAKER, EDWARD. *A First Course in Mathematics for Students of Engineering and the Physical Sciences.* Pp. xiii + 295. D. Van Nostrand Company, Inc. $3.00.

COURANT, RICHARD and HERBERT ROBBINS. *What is Mathematics?* Pp. xix + 521. Oxford University Press, New York. $5.00.

COX, JOSEPH F. and LYMAN JACKSON. *Field Crops and Land Uses.* Illustrated. Pp. xiv + 473. John Wiley and Sons, Inc. $3.75.

FREAR, DONALD E. H. *Chemistry of Insecticides and Fungicides.* Illustrated. Pp. viii + 300. D. Van Nostrand Company, Inc. $4.00.

HOSKINS, MARGARET M. and GERRIT VEVELANDER. *Outline of Histology.* Illustrated. Pp. 112. C. V. Mosby Company.

KISER, CLYDE V. *Group Differences in Urban Fertility.* Pp. xii + 284. The Williams and Wilkins Co. $2.50.

KOL, ERZSÉBET. *The Snow and Ice Algae of Alaska.* Illustrated. 6 plates. Pp. 36. Smithsonian Institution.

LANDIS, CARNEY and M. MARJORIE BOLLES. *Personality and Sexuality of the Physically Handicapped Woman.* Pp. xii + 171. Paul B. Hoeber, Inc. $3.00.

WILSON, CHARLES MORROW. *Ambassadors in White.* Illustrated. Pp. x + 372. Henry Holt and Company. $3.50.

[4] L. Hahn and G. Hevesy, *Nature*, 144: 72, 1939.